


PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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|---|--|---|--|--|
| Applicant's or agent's file reference PA135296/PCT | | FOR FURTHER ACTION | | See Form PCT/PEA/416 |
| International application No. PCT/IB2004/002404 | | International filing date (day/month/year) 27.07.2004 | | Priority date (day/month/year) 04.08.2003 |
| International Patent Classification (IPC) or national classification and IPC G01N27/30, G01N27/403, G01N27/416, G01N27/48, G01N27/49 | | | | |
| Applicant ELEMENT SIX LIMITED et al. | | | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 1 sheets, as follows:</p> <p style="margin-left: 40px;"><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | | | |
| <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p> | | | | |
| Date of submission of the demand 01.06.2005 | | Date of completion of this report 11.11.2005 | | |
| Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | | Authorized Officer Purdie, D Telephone No. +49 89 2399-2187 | | |



**INTERNATIONAL PRELIMINARY REPORT
 ON PATENTABILITY**

International application No.
 PCT/IB2004/002404

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-16 as originally filed

Claims, Numbers

8(part), 9-15 as originally filed
 1-7, 8(part) filed with telefax on 30.06.2005

Drawings, Sheets

1/2, 2/2 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
 - ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing *(specify)*:
 - ☐ any table(s) related to sequence listing *(specify)*:
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
 - ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing *(specify)*:
 - ☐ any table(s) related to sequence listing *(specify)*:

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
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International application No.
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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------|
| Novelty (N) | Yes: Claims | 1-15 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-15 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-15 |
| | No: Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following documents:

- D1: US-A-5 089 802 (YAMAZAKI SHUNPEI) 18 February 1992 (1992-02-18)
- D2: MADORE C, DURET A, HAENNI W AND PERRET A: "Detection of Trace Silver and Copper at an Array of Boron--Doped Microdisk Electrodes"
PROCEEDINGS OF THE SYMPOSIUM ON MICROFABRICATED SYSTEMS
AND MEMS, vol. 2000-19, 27 October 2000 (2000-10-27), pages 159-168,
XP002306592
- D3: EP-A-1 156 136 (UNIV TOKYO) 21 November 2001 (2001-11-21)
- D4: FUJISHIMA A ET AL: "New directions in structuring and electrochemical applications of boron-doped diamond thin films" DIAMOND AND RELATED MATERIALS, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL, vol. 10, no. 9-10, September 2001 (2001-09), pages 1799-1803, XP004321124 ISSN: 0925-9635
- D5: US-A-5 844 252 (SHIKATA SHIN-ICHI ET AL) 1 December 1998 (1998-12-01)
- D6: SOH K L ET AL: "CVD diamond anisotropic film as electrode for electrochemical sensing" SENSORS AND ACTUATORS B, ELSEVIER SEQUOIA S.A., LAUSANNE, CH, vol. 91, no. 1-3, 1 June 2003 (2003-06-01), pages 39-45, XP004424393 ISSN: 0925-4005

The documents regarded as being closest to the subject-matter of claim 1 is D2, which discloses a diamond based electrochemical sensing microelectrode.

The active surface of the electrode disclosed in D2 is composed of boron-doped diamond, onto which a layer of Si_3N_4 is deposited in a way to leave exposed microdisk electrodes (see Experimental section and Fig. 1).

The subject-matter of claim 1 differs from the disclosure in D2 in that the non-conducting layer is diamond, as opposed to Si_3N_4 , and that the diamond electrode surface extends at least partially through the non-conducting layer.

Other documents cited in the search report which are of particular relevance to the

application as a whole are D3, which discloses an array of diamond cylinders (Fig. 6), D4, which discloses a microstructured diamond film (see Fig. 2, for example), and D6, which discloses a CVD grown diamond tip array (Fig. 4). In each of these documents, the electrode disclosed is either intended, or is suitable, for use as an electrochemical microelectrode.

The remaining documents cited in the search report, D1 and D5, are of less relevance to the application as a whole, but are nevertheless relevant to the subject-matter of the claims.

D1 discloses a diamond thermistor, which does not fall within the scope of claim 1. However, during the manufacture of this thermistor there is an intermediate stage at which an object covered by the scope of claim 1 is arrived at (see Fig. 1B of D1). The teaching of D1 is nevertheless for the final device, and there is nothing that would suggest to the skilled man that the method of producing this final device should be interrupted. For this reason, D1 is not considered as a novelty destroying disclosure for the subject-matter of claim 1.

D5 discloses a diamond based field-emission device, in which diamond projections (122 in Fig. 2F) extend at least partially through a layer of nonconducting diamond (undoped diamond layer 13 in Fig. 2F). The projections of diamond in D5 are formed by etching layers 12 and 13, which are of doped and undoped diamond respectively (see D5, col. 7, lines 13-15). Thus the projections are not of electrically conducting diamond. The projections of the subject-matter of claim 1 are of electrically conducting diamond, and this feature differentiates claim 1 from the disclosure of D5.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as how to provide an electrochemical sensing microelectrode which is alternative to that disclosed in D2.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT), there being no suggestion in any of the other cited documents to either replace the non-conducting Si_3N_4 layer with diamond, to

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extend the diamond electrode surface at least partially through the non-conducting layer.

The novelty and inventiveness of each of claims 2-15 is ensured through the dependence on claim 1.

CLAIMS:

1. An electrochemical sensing microelectrode comprising a diamond layer formed from electrically non-conducting diamond and containing one or more pins or projections of electrically conducting diamond extending at least partially through the layer of non-conducting diamond and presenting areas of electrically conducting diamond.
2. A microelectrode according to claim 1, wherein the pins or projections extend to a surface of the layer of electrically non-conducting diamond presenting areas of electrically conducting diamond co-planar with that surface.
3. A microelectrode according to claim 1, wherein the areas of electrically conducting material are recessed relative with a surface of the diamond layer creating a well or reservoir in that surface.
4. A microelectrode according to any one of claims 1 to 3, wherein pins or projections of electrically conducting diamond present circular areas of electrically conducting diamond.
5. A microelectrode according to claim 3, wherein the well or reservoir contains an additive which presents a surface co-planar with the surface in which the well or reservoir is created.
6. A microelectrode according to claim 5, wherein the additive modifies the sensitivity or selectivity of the electrode behaviour.
7. A microelectrode according to claim 5 or claim 6, wherein the additive is an electrochemical (bio-)chemical.
8. A microelectrode according to claim 1, wherein the areas of electrically conducting diamond are in electrical connection with one

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